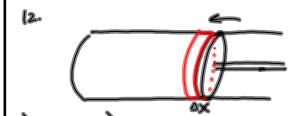
12.



a) $\int_{(P_1,V_1)}^{(P_2,V_2)} P\,dv = \int_{V_1}^{V_2} P\,dv$

P = pressure $\left(\frac{lb}{in^2}\right)$

V = volume

$P = \frac{F}{area}$

$F = P \cdot area$

b) $V_1 = 243 \quad V_2 = 32$

$P_1 = 50 \quad P = ?$

$PV^{1.4} = k$

$50 \cdot 243^{1.4} = k$

$\Delta W = F\,\Delta x$

$W = \int_{x=0}^{x_2} F\,dx$

$\Delta W = P \cdot area \cdot \Delta x$

$= P \cdot \Delta v$

$W = \int_{V_1}^{V_2} P\,dv$

$W = \int_{243}^{32} P\,dv$

$W = \int_{243}^{32} \frac{k}{V^{1.4}}\,dv$

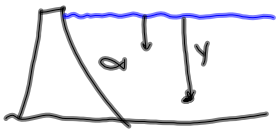
Jan 6-10:00 AM

7.5b Applications of Integrals

Fluid pressure

Why are dams thicker at the bottom? more water pressure

Does the fluid pressure at any point on a dam depend on the amount of water held back by the dam? No, only depends on depth



P = pressure

y = depth

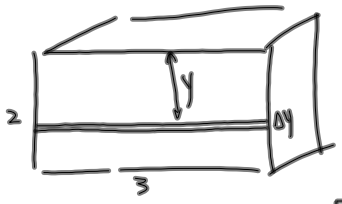
$P = ky$

$P = wy$

k = w = weight density

Dec 17-7:34 PM

What is the total force on the front side of an aquarium if the side is 3ft wide by 2ft tall?



$\Delta F = P \cdot area$

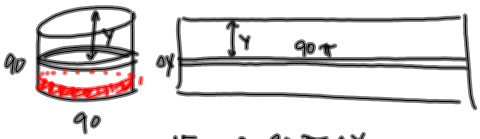
$\Delta F = ky \cdot 3\,\Delta y$

$F = \int_0^2 62.4 \cdot y \cdot 3\,dy$

$F = 374$ lbs

Dec 17-7:38 PM

The Puritan Distilling Company had a 90 ft high, 90 ft diameter cylindrical metal tank filled with molasses which weighs 100 lb/ft^3. In 1919 the tank exploded due to fluid pressure. What was the total fluid force on the tank wall?



$\Delta F = P \cdot 90\pi\,\Delta y$

$\Delta F = 100y\,90\pi\,\Delta y$

whole tank

$F = \int_0^{90} 100y\,90\pi\,dy$

$= 364{,}500\pi = 1{,}145{,}115.52$ lbs

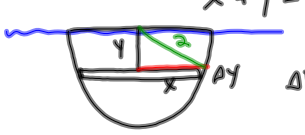
bottom foot

$\int_{89}^{90} 100y\,90\pi\,dy = 2{,}530{,}552.9$

Dec 17-7:39 PM

A steel plate in the shape of a semicircle is submerged vertically in sea water. Find the fluid force on the plate if it has a 4 ft diameter.

$x^2 + y^2 = 2^2 \quad x = \sqrt{4 - y^2}$



$\Delta F = P\,\Delta A$

$= P \cdot 2x\,\Delta y$

$= ky \cdot 2x\,\Delta y$

$F = \int_0^2 ky\,2x\,dy$

$= \int_0^2 62.4 \cdot y \cdot 2\sqrt{4 - y^2}\,dy$

Dec 17-7:45 PM